FIG. 1

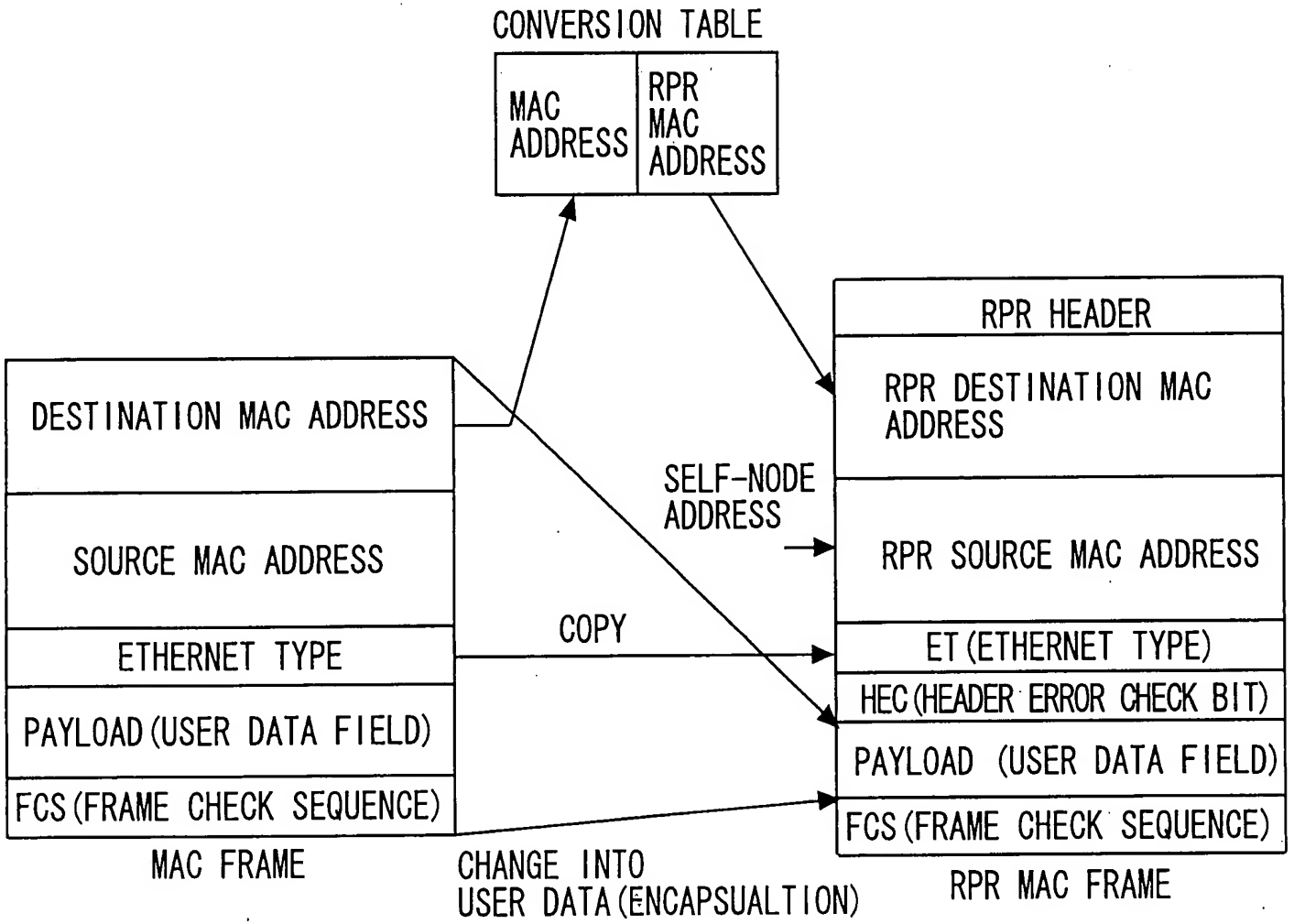

CONVERSION TABLE
MAC ADDRESS
RPR MAC ADDRESS
DESTINATION MAC ADDRESS
SOURCE MAC ADDRESS
ETHERNET TYPE
PAYLOAD (USER DATA FIELD)
FCS (FRAME CHECK SEQUENCE)
MAC FRAME
SELF-NODE ADDRESS
COPY
CHANGE INTO USER DATA (ENCAPSUALTION)
RPR HEADER
RPR DESTINATION MAC ADDRESS
RPR SOURCE MAC ADDRESS
ET (ETHERNET TYPE)
HEC (HEADER ERROR CHECK BIT)
PAYLOAD (USER DATA FIELD)
FCS (FRAME CHECK SEQUENCE)
RPR MAC FRAME

FIG. 2

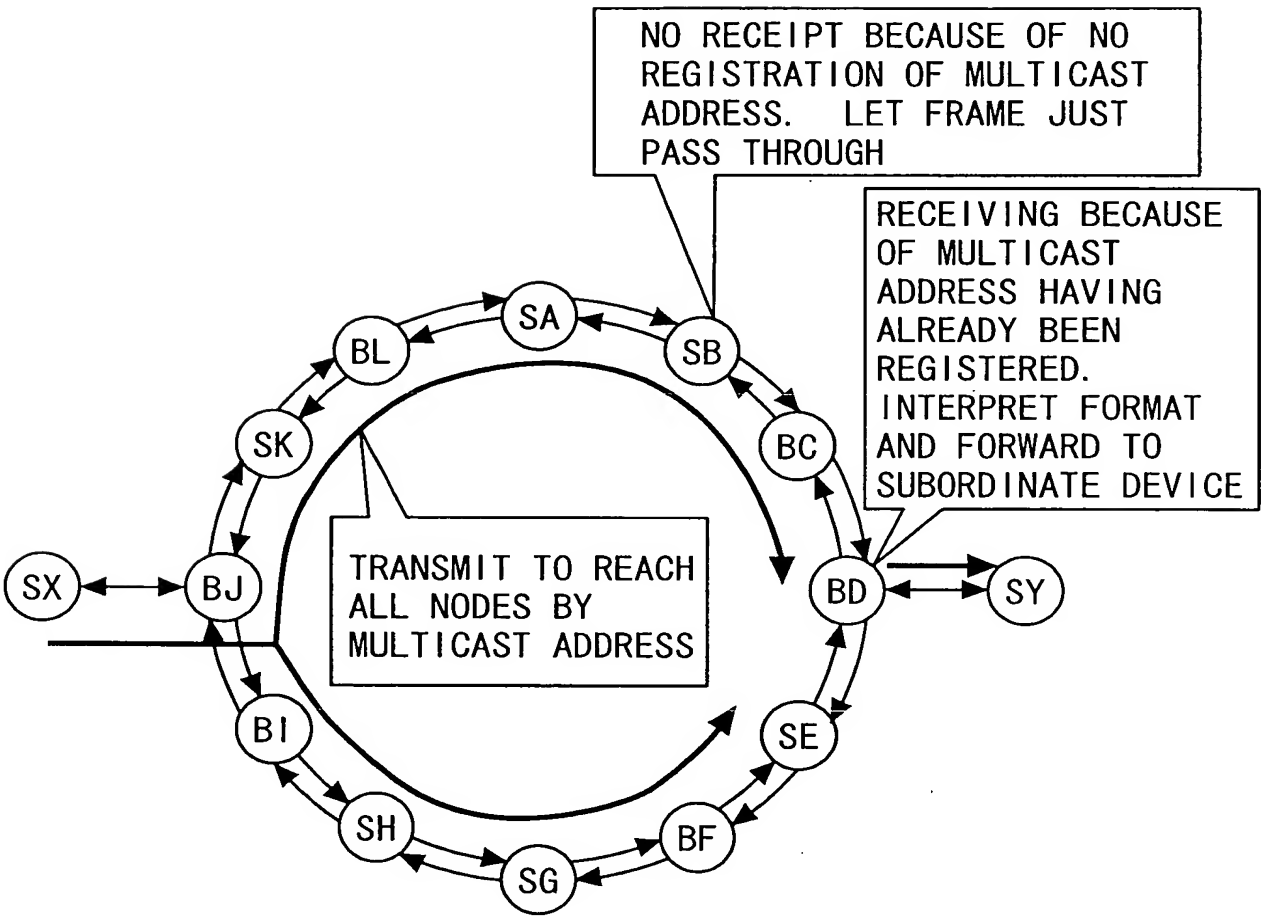

NO RECEIPT BECAUSE OF NO REGISTRATION OF MULTICAST ADDRESS. LET FRAME JUST PASS THROUGH
RECEIVING BECAUSE OF MULTICAST ADDRESS HAVING ALREADY BEEN REGISTERED. INTERPRET FORMAT AND FORWARD TO SUBORDINATE DEVICE
TRANSMIT TO REACH ALL NODES BY MULTICAST ADDRESS
SA
SB
BC
BD
SY
SE
BF
SG
SH
BI
BJ
SX
SK
BL

FIG. 3

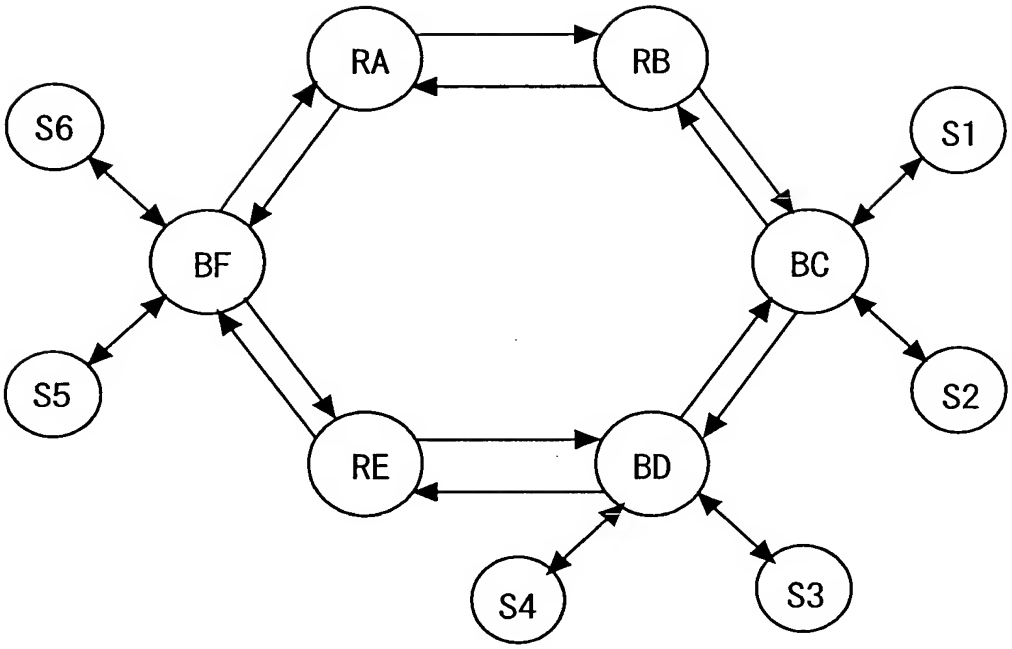


FIG. 4

DEVICE NAME	TYPE	IP ADDRESS	MAC ADDRESS	DEVICE NAME	TYPE	IP ADDRESS	MAC ADDRESS
RA	ROUTER (RPR NODE)	10.1.0.1	MRA	S1	STATION	10.1.0.10	MS1
RB	ROUTER (RPR NODE)	10.1.0.2	MRB	S2	STATION	10.1.0.11	MS2
BC	BRIDGE (RPR NODE)	—	MBC	S3	STATION	10.1.0.12	MS3
BD	BRIDGE (RPR NODE)	—	MBD	S4	STATION	10.1.0.13	MS4
RE	ROUTER (RPR NODE)	10.1.0.3	MRE	S5	STATION	10.1.0.14	MS5
BF	BRIDGE (RPR NODE)	—	MBF	S6	STATION	10.1.0.15	MS6

FIG. 5A

1) RA

NODE NAME	MAC ADDRESS	OUTER		INNER	
		TTL	STATUS	TTL	STATUS
RA	MRA	—	—	—	—
RB	MRB	1	IDLE	5	IDLE
RG	MBC	2	IDLE	4	IDLE
BD	MBD	3	IDLE	3	IDLE
RE	MRE	4	IDLE	2	IDLE
BF	MBF	5	IDLE	1	IDLE

FIG. 5B

2) RB

NODE NAME	MAC ADDRESS	OUTER		INNER	
		TTL	STATUS	TTL	STATUS
RB	MRB	—	—	—	—
BC	MBC	1	IDLE	5	IDLE
BD	MBD	2	IDLE	4	IDLE
RE	MRE	3	IDLE	3	IDLE
BF	MBF	4	IDLE	2	IDLE
RA	MRA	5	IDLE	1	IDLE

FIG. 5C

3) BC

NODE NAME	MAC ADDRESS	OUTER		INNER	
		TTL	STATUS	TTL	STATUS
BC	MBC	—	—	—	—
BD	MBD	1	IDLE	5	IDLE
RE	MRE	2	IDLE	4	IDLE
BF	MBF	3	IDLE	3	IDLE
RA	MRA	4	IDLE	2	IDLE
RB	MRB	5	IDLE	1	IDLE

FIG. 5D

4) BD

NODE NAME	MAC ADDRESS	OUTER		INNER	
		TTL	STATUS	TTL	STATUS
BD	MBD	—	—	—	—
RE	MRE	1	IDLE	5	IDLE
BF	MBF	2	IDLE	4	IDLE
RA	MRA	3	IDLE	3	IDLE
RB	MRB	4	IDLE	2	IDLE
BC	MBC	5	IDLE	1	IDLE

FIG. 5E

5) RE

NODE NAME	MAC ADDRESS	OUTER		INNER	
		TTL	STATUS	TTL	STATUS
RE	MRE	—	—	—	—
BF	MBF	1	IDLE	5	IDLE
RA	MRA	2	IDLE	4	IDLE
RB	MRB	3	IDLE	3	IDLE
BC	MBC	4	IDLE	2	IDLE
BD	MBD	5	IDLE	1	IDLE

FIG. 5G

6) BF

NODE NAME	MAC ADDRESS	OUTER		INNER	
		TTL	STATUS	TTL	STATUS
BF	MBF	—	—	—	—
RA	MRA	1	IDLE	5	IDLE
RB	MRB	2	IDLE	4	IDLE
BC	MBC	3	IDLE	3	IDLE
BD	MBD	4	IDLE	2	IDLE
RE	MRE	5	IDLE	1	IDLE

FIG. 6A

DA=BC
SA=MS1
PT=0x0806
ARP HEADER (ARP REQUEST)
SA=MS1
SIP=10.1.0.10
DA=NULL
DIP=10.1.0.15
FCS

ORIGINAL ARP PACKET TO BE TRANSMITTED BY S1

FIG. 6B

RPR HEADER
DA=BC
SA=MS1
PT=0x0806
HEC
ARP HEADER (ARP REQUEST)
SA=MS1
SIP=10.1.0.10
DA=NULL
DIP=10.1.0.15
FCS

RPR-ENCAPSULATED ARP PACKET TO BE TRANSMITTED BY BC

FIG. 6C

DA=MS1
SA=MS6
PT=0x0806
ARP HEADER (ARP RESPONSE)
SA=MS6
SIP=10.1.0.15
DA=MS1
DIP=10.1.0.10
FCS

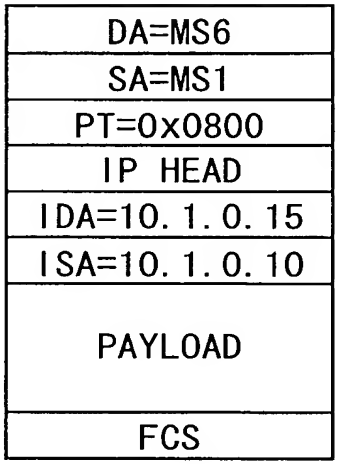
ARP RESPONSE PACKET TO BE TRANSMITTED BY S6

FIG. 6D

RPR HEADER
DA=MC
SA=MBF
PT=0x0806
HEC
DA=MS1
SA=MS6
PT=0x0806
ARP HEADER (ARP RESPONSE)
SA=MS6
SIP=10.1.0.15
DA=MS1
DIP=10.1.0.10
FCS

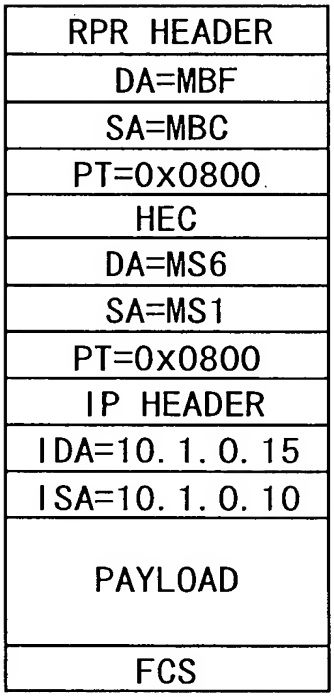
ENCAPSUALTED ARP RESPONSE PACKET TO BE TRANSMITTED BY BF

FIG. 7A



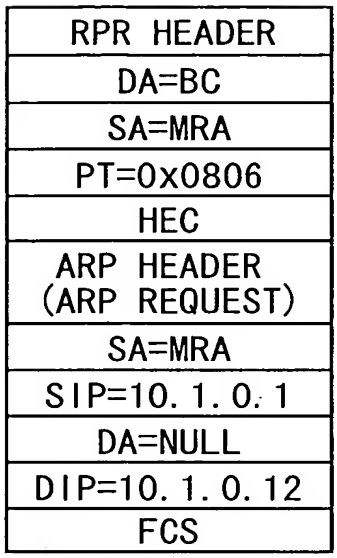
IP DATA PACKET
TO BE TRANSMITTED
BY S1

FIG. 7B



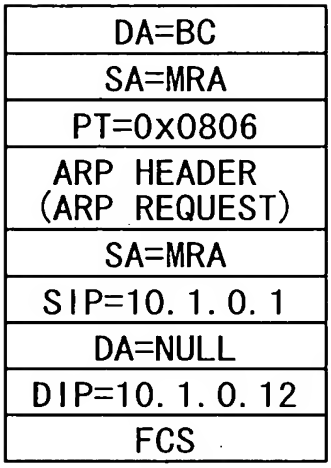
ENCAPSUALTED IP
DATA PACKET TO
BE TRANSMITTED
BY BC

FIG. 8A



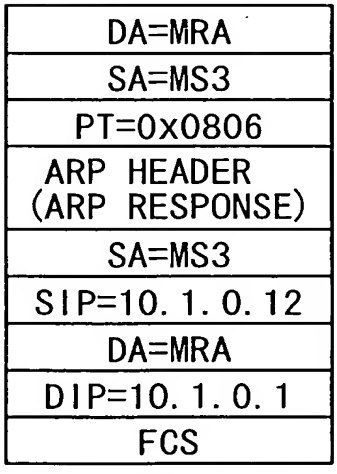
ARP PACKET TO BE TRANSMITTED BY RA

FIG. 8B



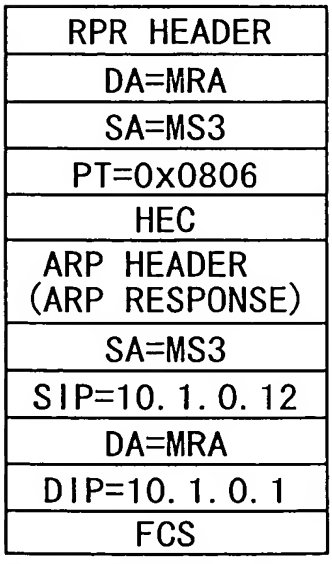
ARP REQUEST PACKET TO BE TRANSMITTED BY BD

FIG. 8C



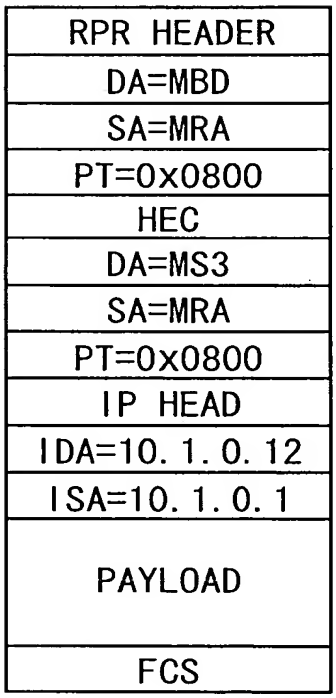
ARP RESPONSE PACKET TO BE TRANSMITTED BY S3

FIG. 8D



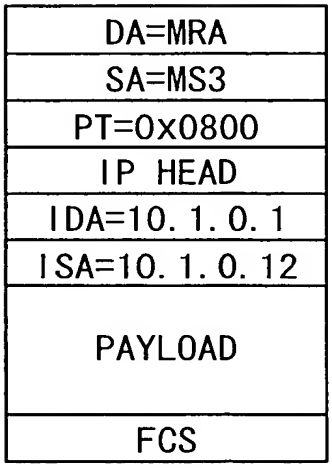
ARP RESPONSE PACKET TO BE TRANSMITTED BY BD

FIG. 9A



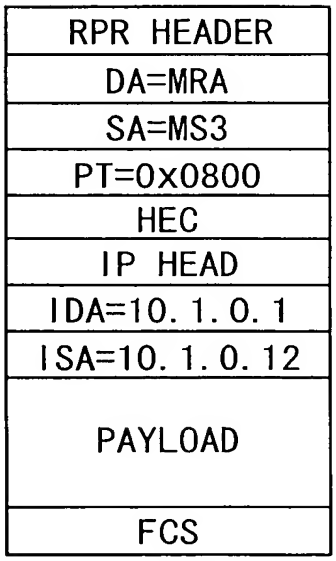
IP DATA PACKET
TO BE TRANSMITTED
BY RA

FIG. 9B



IP DATA PACKET
TO BE TRANSMITTED
BY S3

FIG. 9C



IP DATA PACKET
TO BE TRASLATED
AND TRANSMITTED
BY BD

FIG. 10

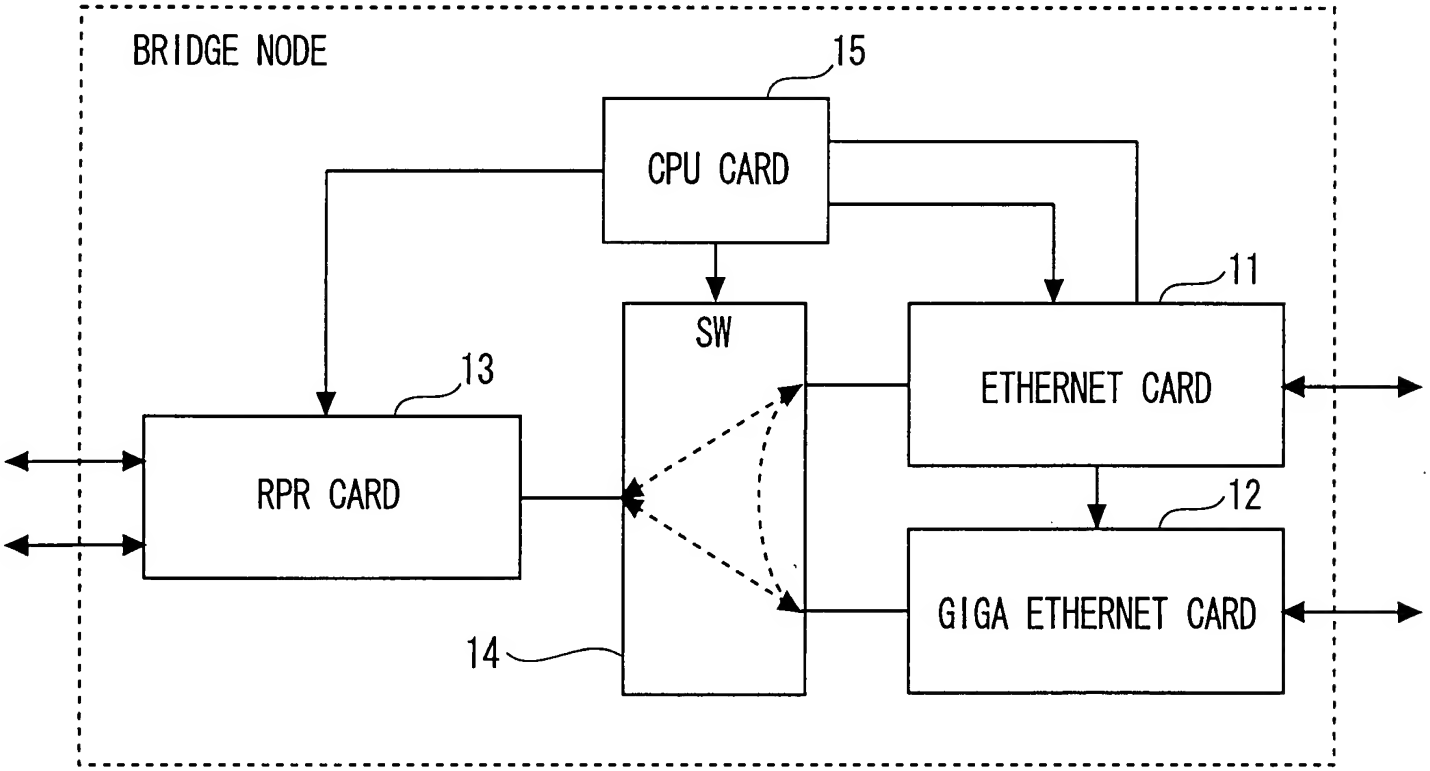

BRIDGE NODE
15
CPU CARD
11
SW
13
ETHERNET CARD
RPR CARD
12
GIGA ETHERNET CARD
14

FIG. 11

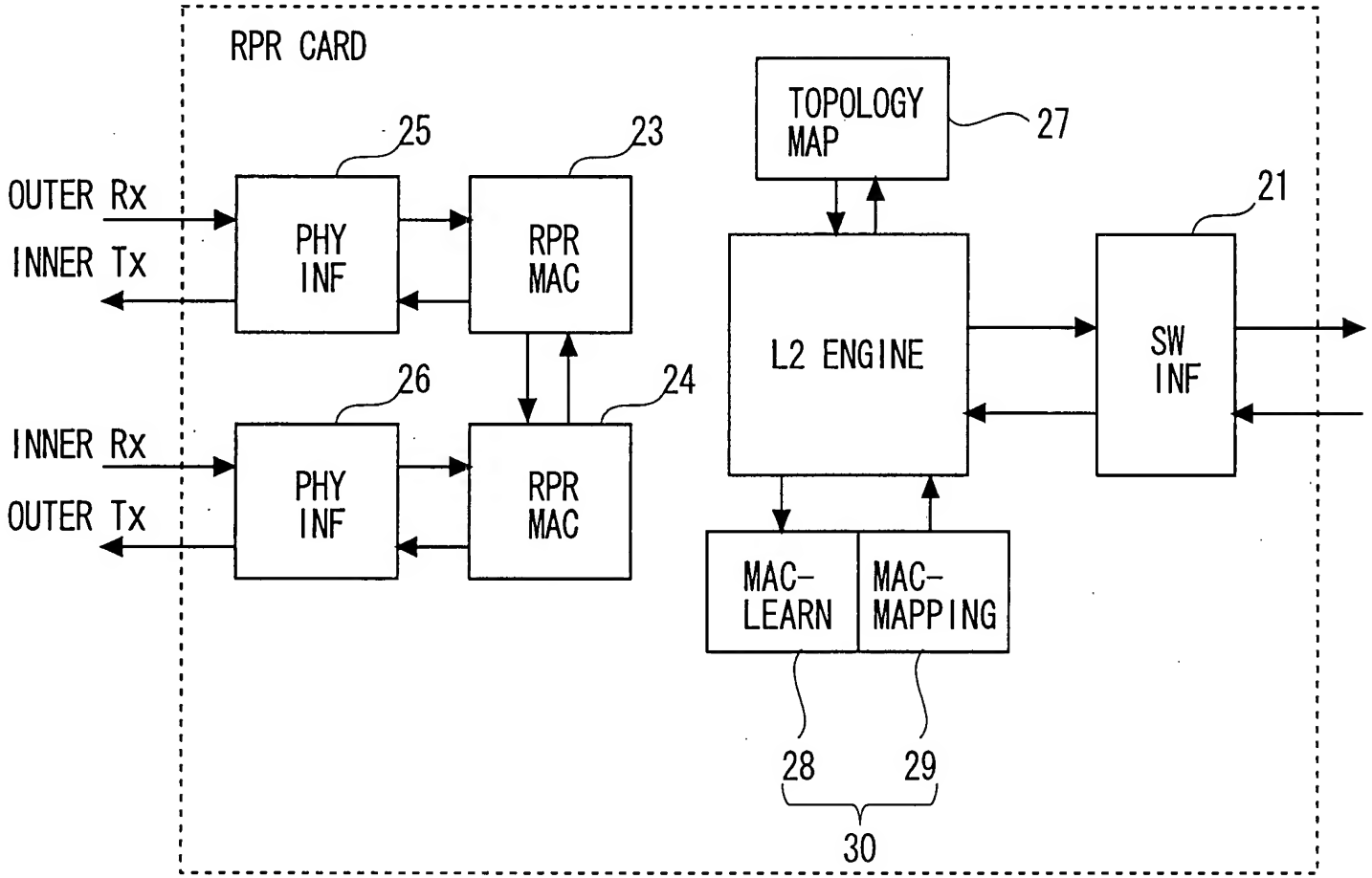

RPR CARD
TOPOLOGY MAP
27
25
23
21
OUTER Rx
INNER Tx
PHY INF
RPR MAC
L2 ENGINE
SW INF
26
24
INNER Rx
OUTER Tx
PHY INF
RPR MAC
MAC-LEARN
MAC-MAPPING
28
29
30

FIG. 12

30

DEVICE NAME	MAC ADDRESS	DEVICE NAME	MAC ADDRESS	PORT NUMBER
RA	MRA	—	—	0 (RPR)
RB	MRB	—	—	0 (RPR)
BC	MBC	S1	MS1	1 (ETHERNET)
		S2	MS2	2 (GETHERNET)
BD	MBD	S3	MS3	0 (RPR)
		S4	MS4	0 (RPR)
RE	MRE	—	—	0 (RPR)
BF	MBF	S5	MS5	0 (RPR)
		S6	MS6	0 (RPR)

FIG. 13

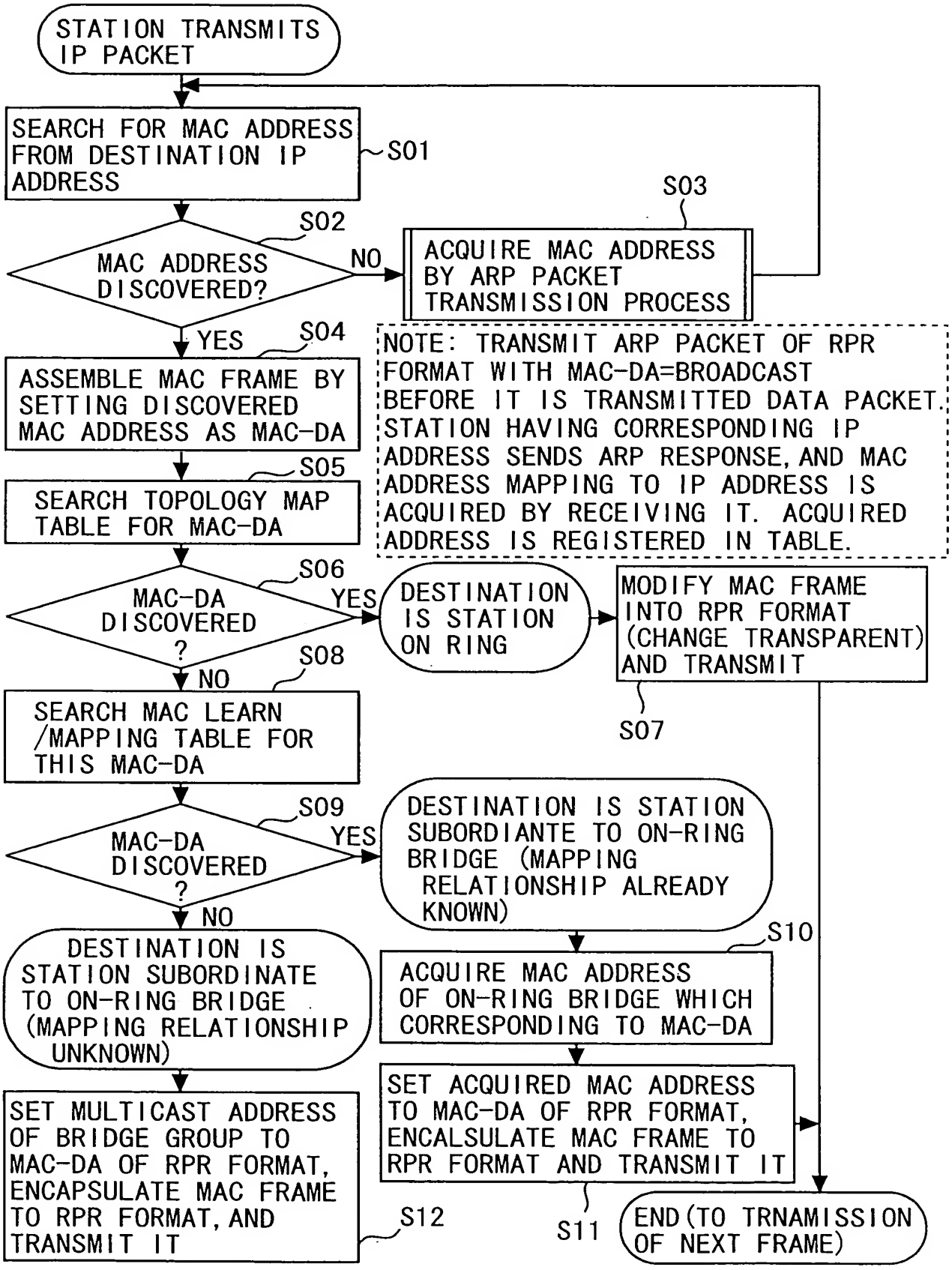

STATION TRANSMITS IP PACKET
SEARCH FOR MAC ADDRESS FROM DESTINATION IP ADDRESS
S01
MAC ADDRESS DISCOVERED?
S02
NO
S03
ACQUIRE MAC ADDRESS BY ARP PACKET TRANSMISSION PROCESS
YES
S04
ASSEMBLE MAC FRAME BY SETTING DISCOVERED MAC ADDRESS AS MAC-DA
S05
SEARCH TOPOLOGY MAP TABLE FOR MAC-DA
NOTE: TRANSMIT ARP PACKET OF RPR FORMAT WITH MAC-DA=BROADCAST BEFORE IT IS TRANSMITTED DATA PACKET. STATION HAVING CORRESPONDING IP ADDRESS SENDS ARP RESPONSE, AND MAC ADDRESS MAPPING TO IP ADDRESS IS ACQUIRED BY RECEIVING IT. ACQUIRED ADDRESS IS REGISTERED IN TABLE.
MAC-DA DISCOVERED ?
S06
YES
DESTINATION IS STATION ON RING
MODIFY MAC FRAME INTO RPR FORMAT (CHANGE TRANSPARENT) AND TRANSMIT
S07
NO
S08
SEARCH MAC LEARN /MAPPING TABLE FOR THIS MAC-DA
MAC-DA DISCOVERED ?
S09
YES
DESTINATION IS STATION SUBORDIANTE TO ON-RING BRIDGE (MAPPING RELATIONSHIP ALREADY KNOWN)
NO
S10
DESTINATION IS STATION SUBORDINATE TO ON-RING BRIDGE (MAPPING RELATIONSHIP UNKNOWN)
ACQUIRE MAC ADDRESS OF ON-RING BRIDGE WHICH CORRESPONDING TO MAC-DA
SET ACQUIRED MAC ADDRESS TO MAC-DA OF RPR FORMAT, ENCALSULATE MAC FRAME TO RPR FORMAT AND TRANSMIT IT
S11
SET MULTICAST ADDRESS OF BRIDGE GROUP TO MAC-DA OF RPR FORMAT, ENCAPSULATE MAC FRAME TO RPR FORMAT, AND TRANSMIT IT
S12
END (TO TRNAMISSION OF NEXT FRAME)

FIG. 14

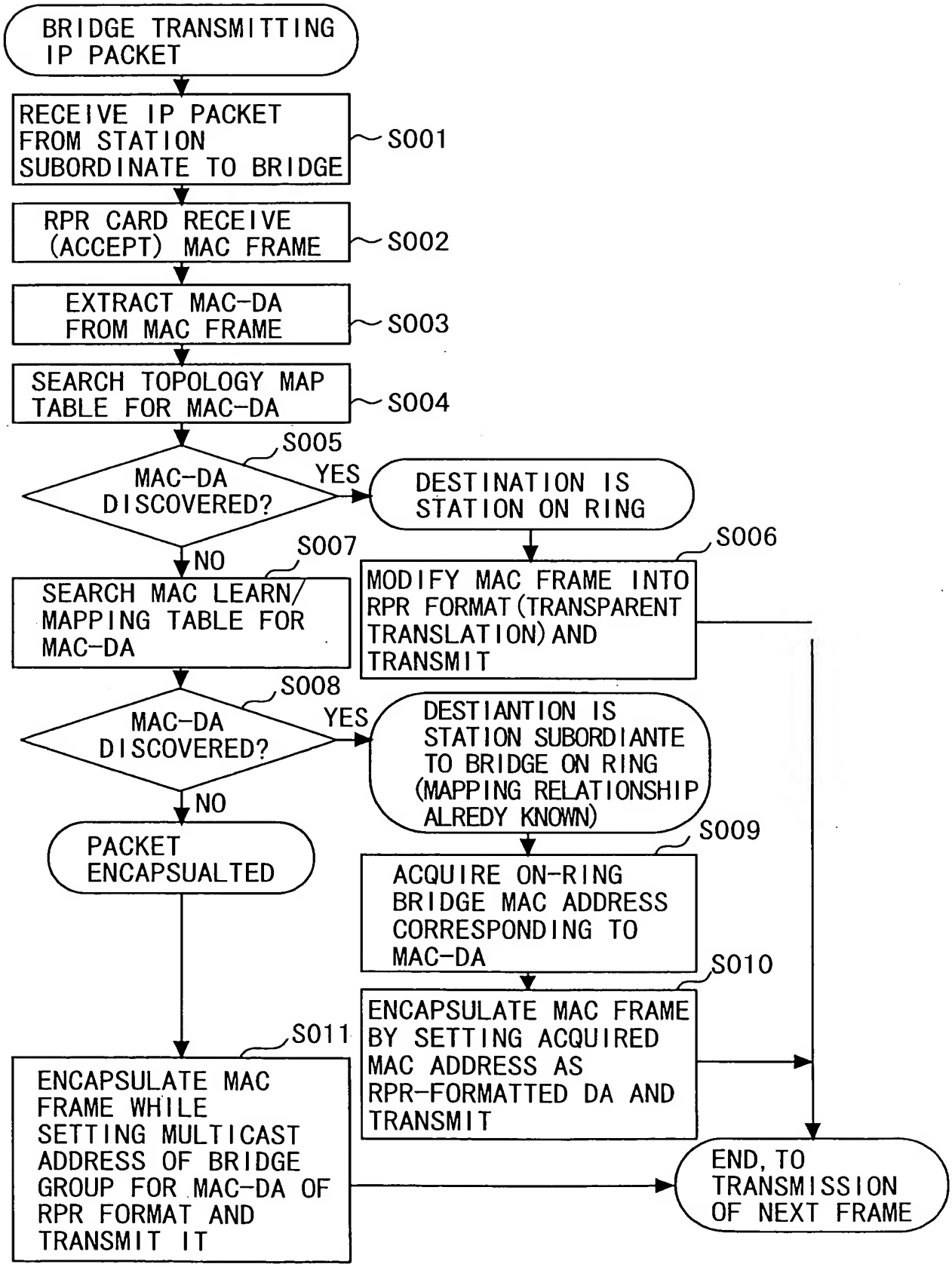

BRIDGE TRANSMITTING IP PACKET
RECEIVE IP PACKET FROM STATION SUBORDINATE TO BRIDGE
S001
RPR CARD RECEIVE (ACCEPT) MAC FRAME
S002
EXTRACT MAC-DA FROM MAC FRAME
S003
SEARCH TOPOLOGY MAP TABLE FOR MAC-DA
S004
S005
MAC-DA DISCOVERED?
YES
DESTINATION IS STATION ON RING
NO
S007
SEARCH MAC LEARN/ MAPPING TABLE FOR MAC-DA
S006
MODIFY MAC FRAME INTO RPR FORMAT (TRANSPARENT TRANSLATION) AND TRANSMIT
S008
MAC-DA DISCOVERED?
YES
DESTIANTION IS STATION SUBORDIANTE TO BRIDGE ON RING (MAPPING RELATIONSHIP ALREDY KNOWN)
NO
PACKET ENCAPSUALTED
S009
ACQUIRE ON-RING BRIDGE MAC ADDRESS CORRESPONDING TO MAC-DA
S010
ENCAPSULATE MAC FRAME BY SETTING ACQUIRED MAC ADDRESS AS RPR-FORMATTED DA AND TRANSMIT
S011
ENCAPSULATE MAC FRAME WHILE SETTING MULTICAST ADDRESS OF BRIDGE GROUP FOR MAC-DA OF RPR FORMAT AND TRANSMIT IT
END, TO TRANSMISSION OF NEXT FRAME

FIG. 15

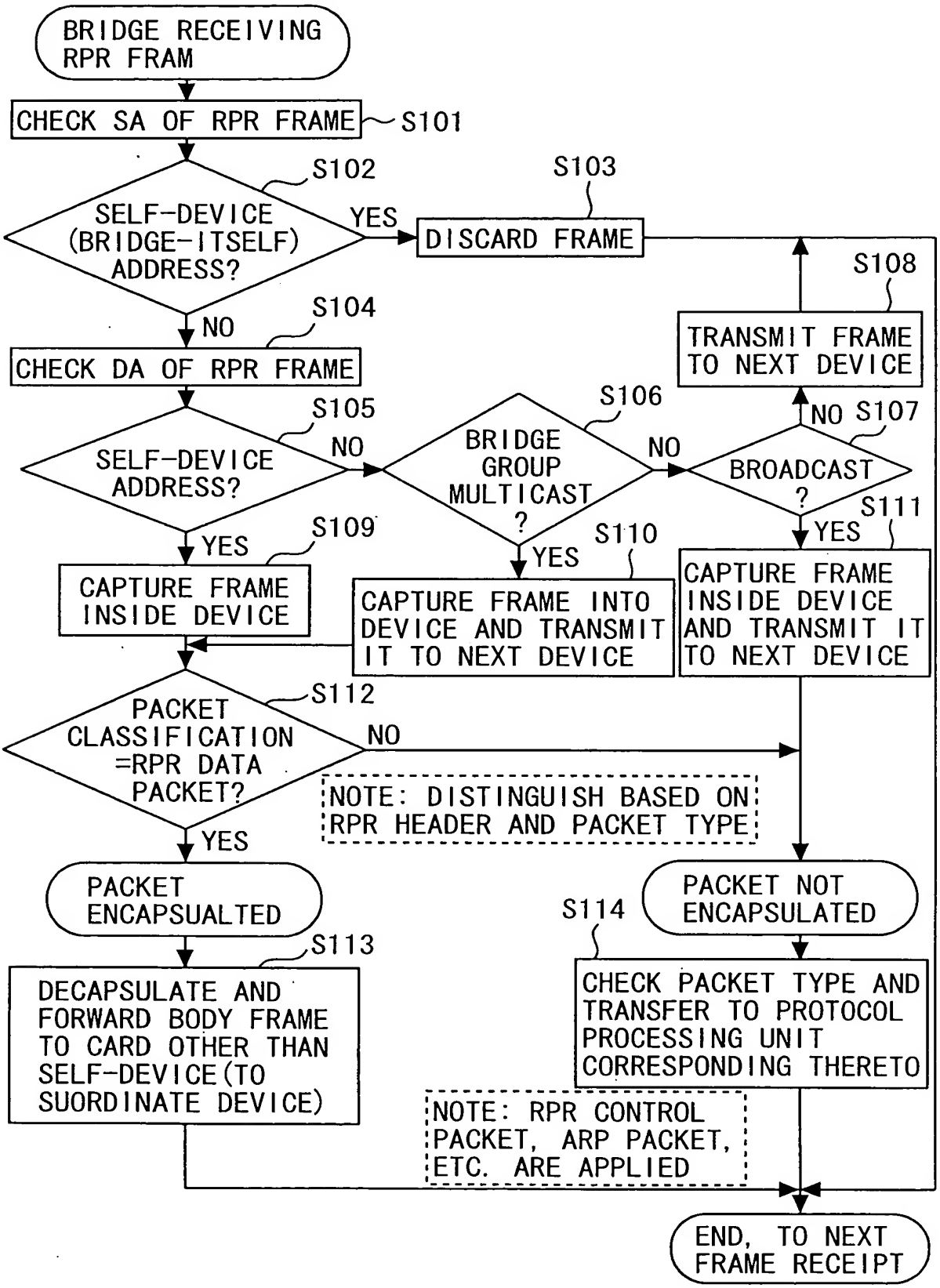

BRIDGE RECEIVING RPR FRAM
CHECK SA OF RPR FRAME
S101
S102
SELF-DEVICE (BRIDGE-ITSELF) ADDRESS?
YES
S103
DISCARD FRAME
NO
S104
CHECK DA OF RPR FRAME
S105
SELF-DEVICE ADDRESS?
NO
S106
BRIDGE GROUP MULTICAST ?
NO
S107
BROADCAST ?
NO
S108
TRANSMIT FRAME TO NEXT DEVICE
YES
S109
CAPTURE FRAME INSIDE DEVICE
YES
S110
CAPTURE FRAME INTO DEVICE AND TRANSMIT IT TO NEXT DEVICE
YES
S111
CAPTURE FRAME INSIDE DEVICE AND TRANSMIT IT TO NEXT DEVICE
S112
PACKET CLASSIFICATION =RPR DATA PACKET?
NO
NOTE: DISTINGUISH BASED ON RPR HEADER AND PACKET TYPE
YES
PACKET ENCAPSUALTED
S113
DECAPSULATE AND FORWARD BODY FRAME TO CARD OTHER THAN SELF-DEVICE(TO SUORDINATE DEVICE)
PACKET NOT ENCAPSULATED
S114
CHECK PACKET TYPE AND TRANSFER TO PROTOCOL PROCESSING UNIT CORRESPONDING THERETO
NOTE: RPR CONTROL PACKET, ARP PACKET, ETC. ARE APPLIED
END, TO NEXT FRAME RECEIPT

FIG. 16

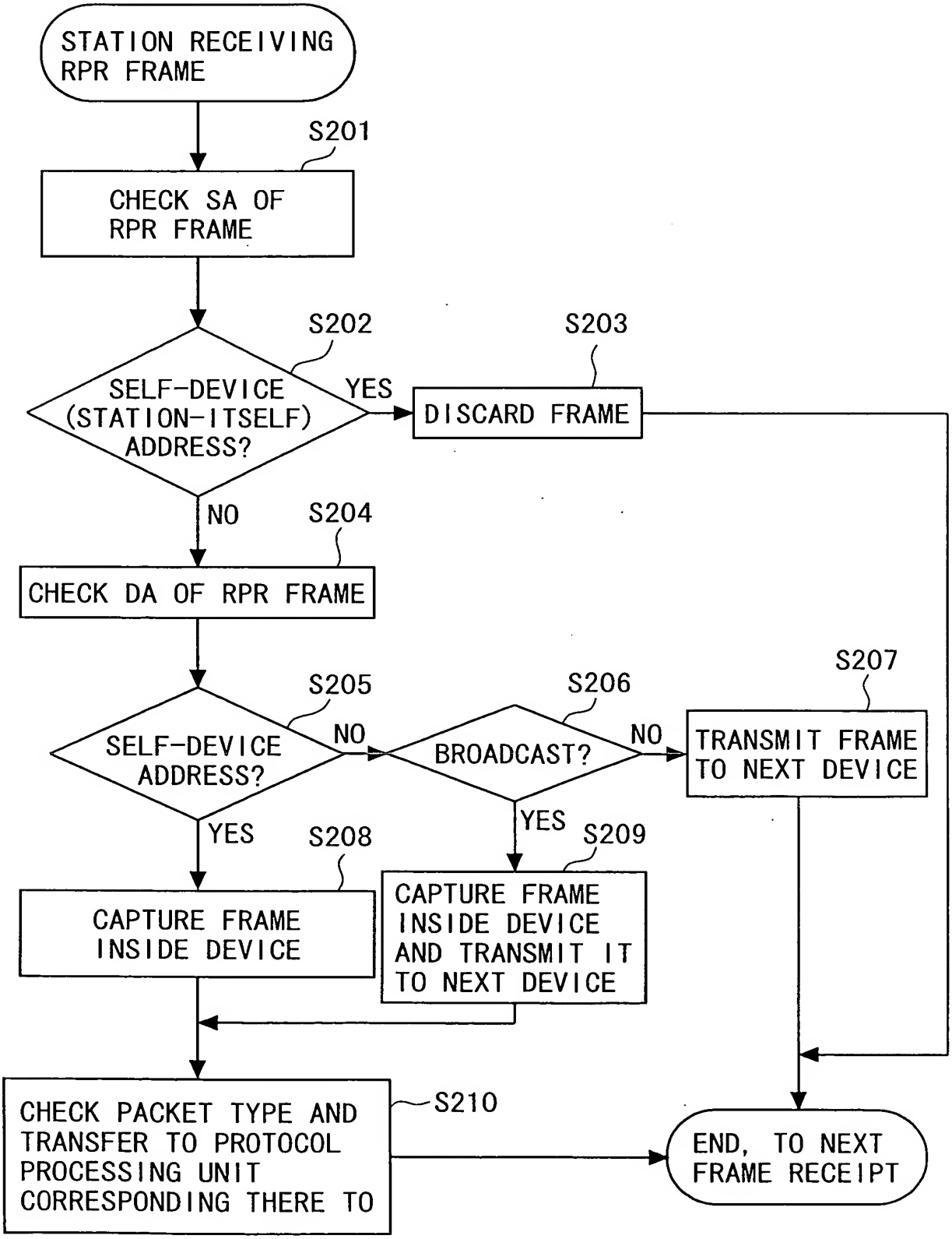

STATION RECEIVING RPR FRAME
S201
CHECK SA OF RPR FRAME
S202
SELF-DEVICE (STATION-ITSELF) ADDRESS?
YES
S203
DISCARD FRAME
NO
S204
CHECK DA OF RPR FRAME
S205
SELF-DEVICE ADDRESS?
NO
S206
BROADCAST?
NO
S207
TRANSMIT FRAME TO NEXT DEVICE
YES
S208
CAPTURE FRAME INSIDE DEVICE
YES
S209
CAPTURE FRAME INSIDE DEVICE AND TRANSMIT IT TO NEXT DEVICE
S210
CHECK PACKET TYPE AND TRANSFER TO PROTOCOL PROCESSING UNIT CORRESPONDING THERE TO
END, TO NEXT FRAME RECEIPT

FIG. 17A

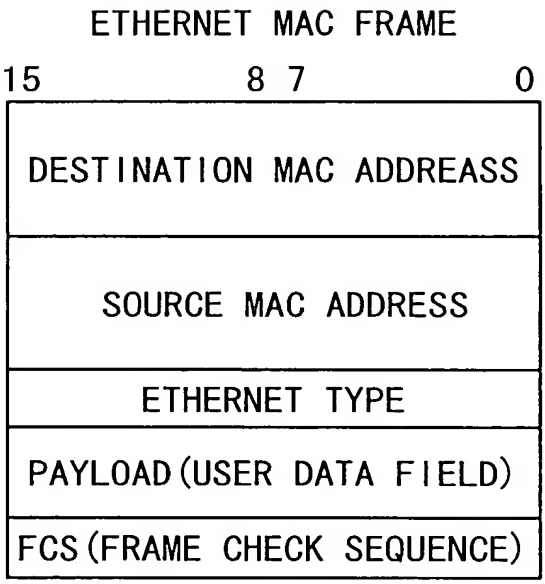
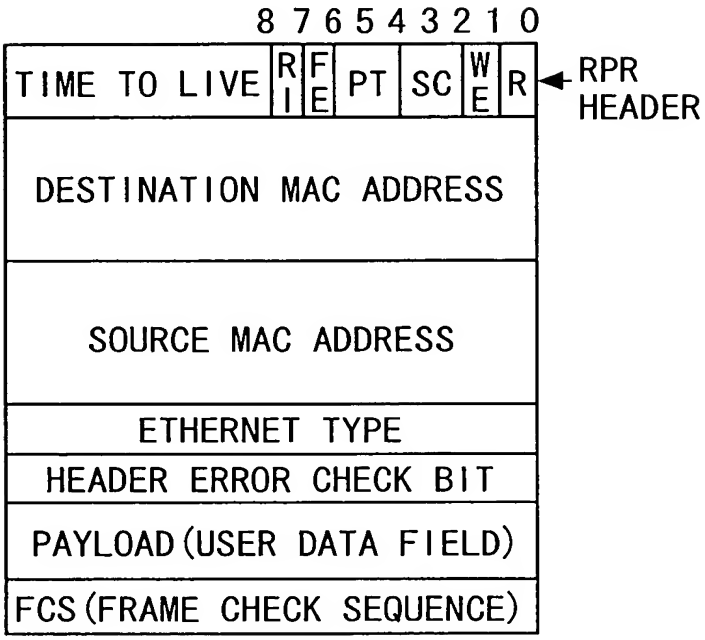

ETHERNET MAC FRAME
15
8 7
0
DESTINATION MAC ADDREASS
SOURCE MAC ADDRESS
ETHERNET TYPE
PAYLOAD(USER DATA FIELD)
FCS(FRAME CHECK SEQUENCE)

FIG. 17B

RRR MAC FRAME



NOTE: MEANINGS OF RESPECTIVE FIELDS OF RPR HEADER,
TTL: INDICATING TIME-TO-LIVE OF FRAME. ONE IS SUBTRACT FROM TTL VALUE (-1) FOR EVERY 1-NODE PASSAGE (DEFINITION OF NODE WILL BE GIVEN IN NEXT ITEM), WHEN RESULT OF DECREASE (-1) BECOMES 0, FRAME IS NOT FORRWARDED TO NEXT NODE.
RI: ID OF RINGLET. RINGLET IS USED WHEN INDICATING ONE OF BIDIRECTIONAL RINGS, AND THIS BIT INDICATES WHICH RINGLET THIS FRAME ORIGINALLY EXISTS. RINGLET 0 = 0, RINGLET 1 = 1.
FE: FE INDICATES WHETHER THIS PACKET IS FAIRNESS CONTROL OBJECT OR NOT. FE = 0, THIS IS NOT FAIRNESS OBJECT, FE = 1, THIS IS FAIRNESS OBJECT.
PT: PT DEFINES PACKET ATTRIBUTE. 00 = PROSPECTIVE RESERVATION, 01 = RPR CONTROL PACKET, 10 = RPR FAIRNESS PACKET, FE = 1, THIS IS FAIRNESS OBJECT.
SC: SERVICE CLASS. , 00 = CLASS C, 01 = CLASS B, 10 = CLASS A (SUBCLASS A1), 11 = CLASS A (SUBCLASS A0, WE: LAPPING FUNCTION PROVIDED OR NON-PROVIDED 0 = NO LAPPING FUNCTION, 1 = LAPPING FUNCTION PROVIDED.
R: PROPSECTIVE RESERVATION

FIG. 18

PRIOR ART

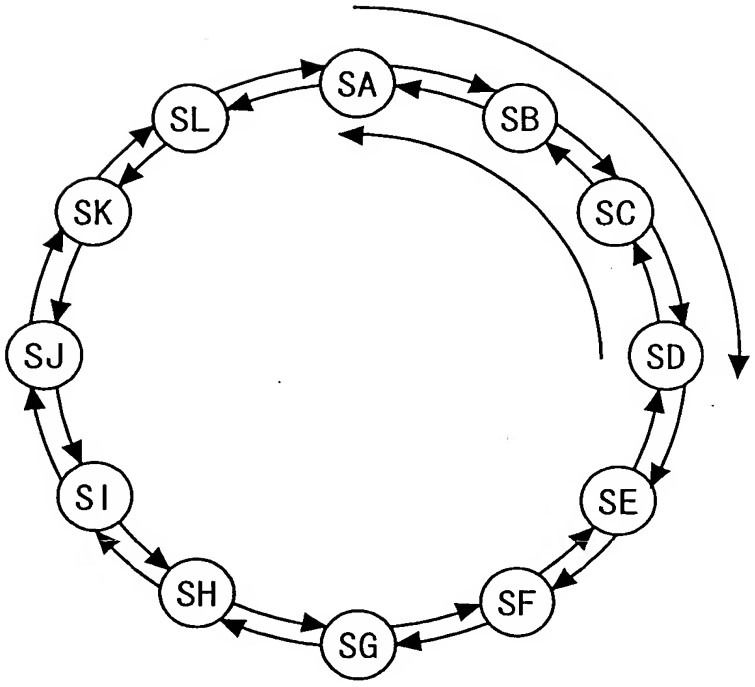


FIG. 19

PRIOR ART

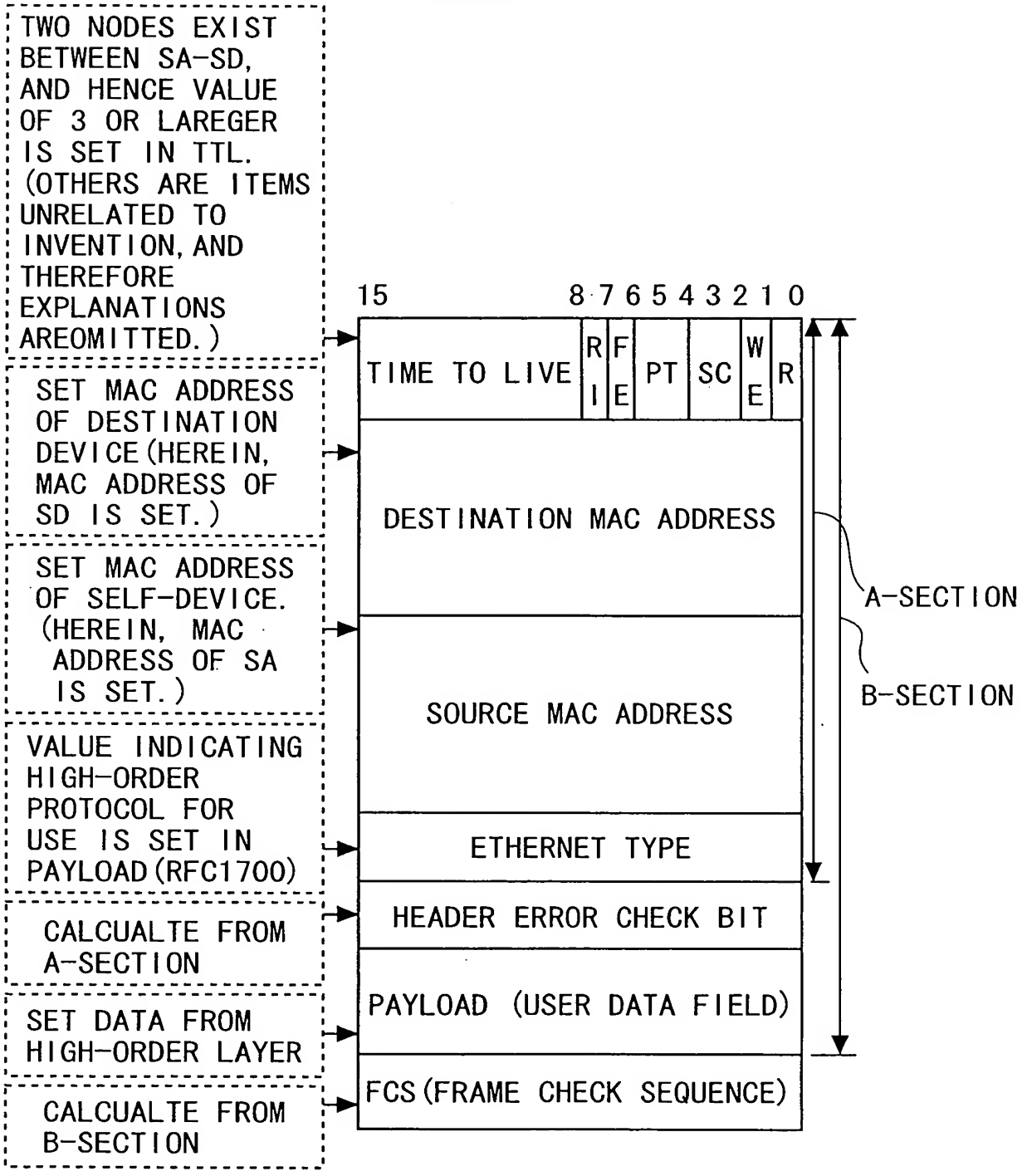


FIG. 20

PRIOR ART

NODE NAME	MAC ADDRESS	OUTER		INNER	
		TTL	STATUS	TTL	STATUS
SA	MSA	—	—	—	—
SB	MSB	1	IDLE	11	IDLE
SC	MSC	2	IDLE	10	IDLE
SD	MSD	3	IDLE	9	IDLE
SE	MSE	4	IDLE	8	IDLE
SF	MSF	5	IDLE	7	IDLE
SG	MSG	6	IDLE	6	IDLE
SH	MSH	7	IDLE	5	IDLE
SI	MSI	8	IDLE	4	IDLE
SJ	MSJ	9	IDLE	3	IDLE
SK	MSK	10	IDLE	2	IDLE
SL	MSL	11	IDLE	1	IDLE

FIG. 21

PRIOR ART

NODE NAME	MAC ADDRESS	OUTER		INNER	
		TTL	STATUS	TTL	STATUS
SA	MSA	—	—	—	—
SB	MSB	1	IDLE	11	IDLE
SC	MSC	2	IDLE	10	IDLE
SD	MSD	3	IDLE→BUSY	9	IDLE
SE	MSE	4	IDLE→BUSY	8	IDLE
SF	MSF	5	IDLE→BUSY	7	IDLE
SG	MSG	6	IDLE→BUSY	6	IDLE
SH	MSH	7	IDLE→BUSY	5	IDLE
SI	MSI	8	IDLE→BUSY	4	IDLE
SJ	MSJ	9	IDLE→BUSY	3	IDLE
SK	MSK	10	IDLE→BUSY	2	IDLE
SL	MSL	11	IDLE→BUSY	1	IDLE

FIG. 22

PRIOR ART

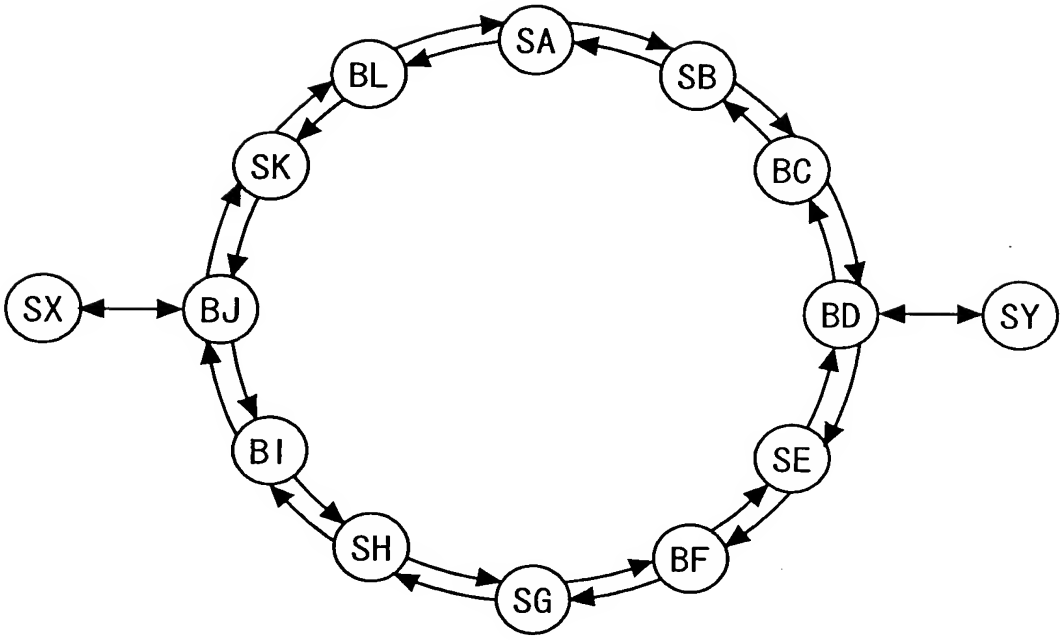


FIG. 23
PRIOR ART

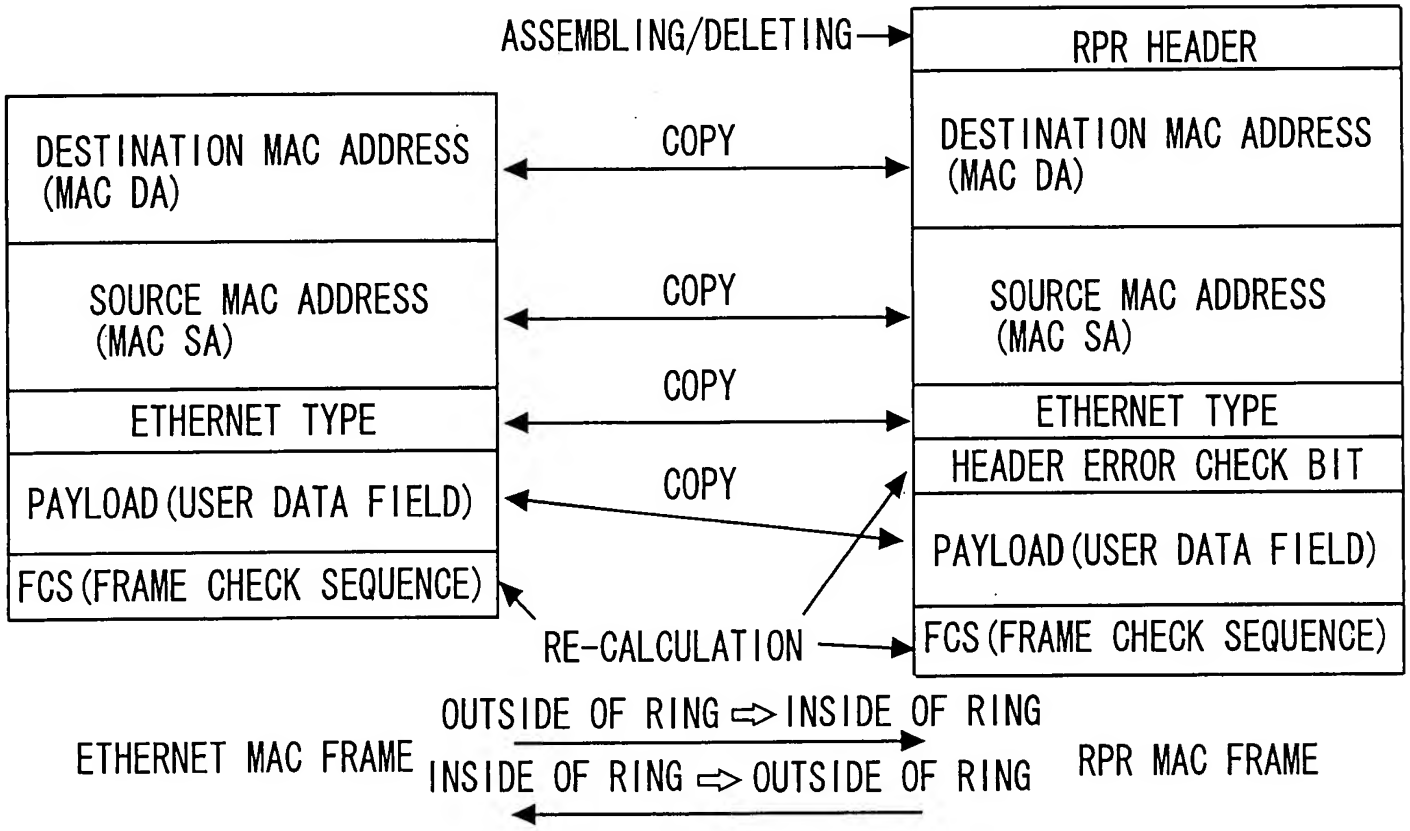


FIG. 24

PRIOR ART

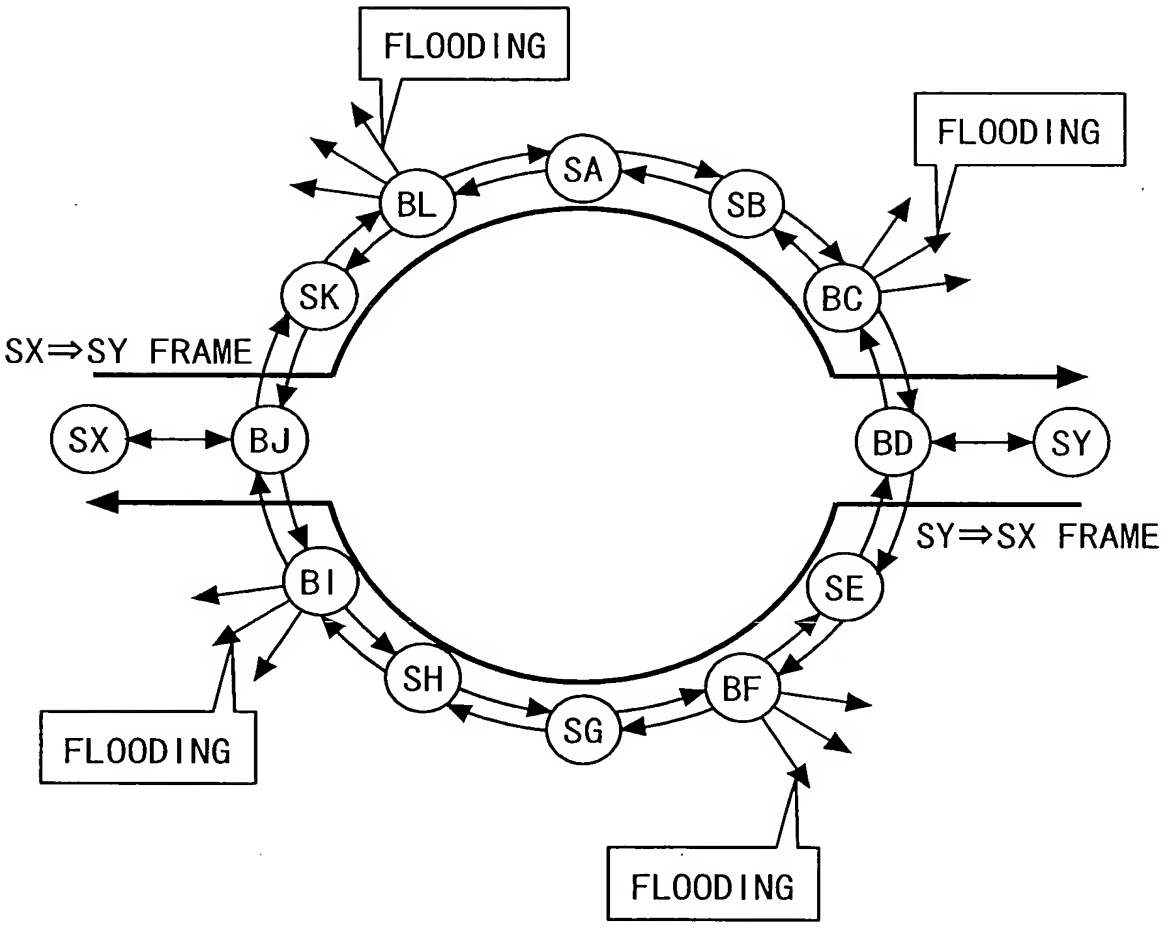


FIG. 25

PRIOR ART

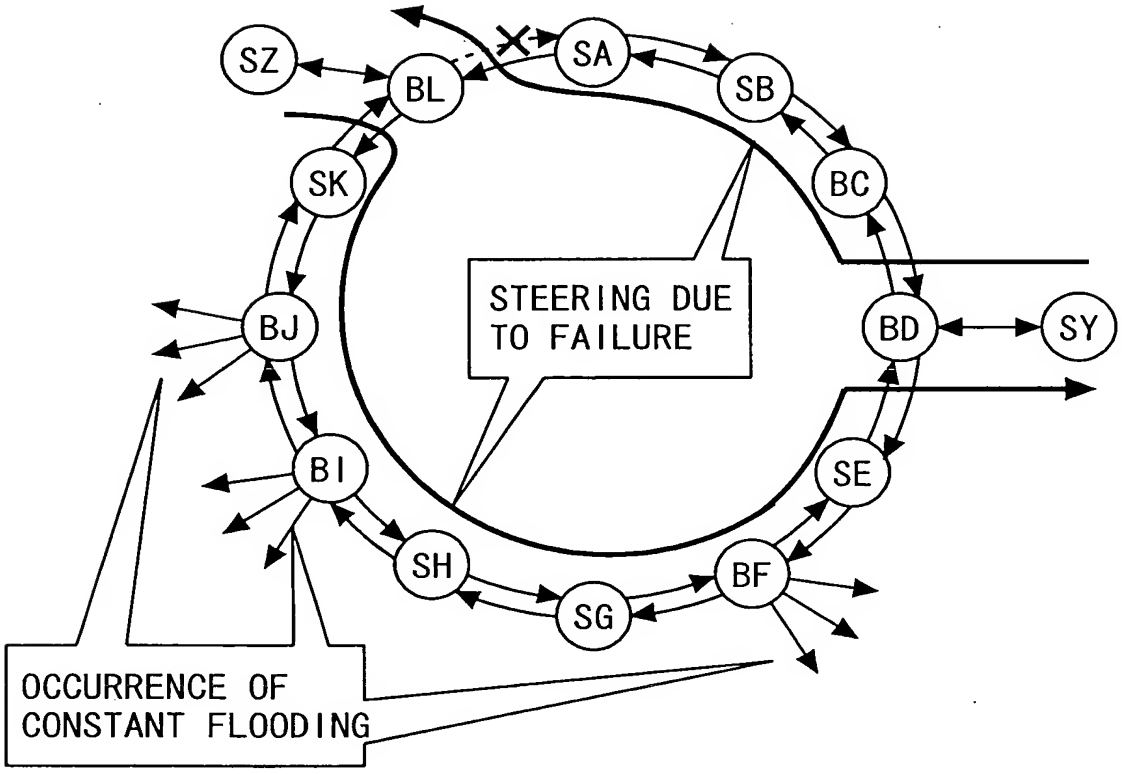


FIG. 26

PRIOR ART

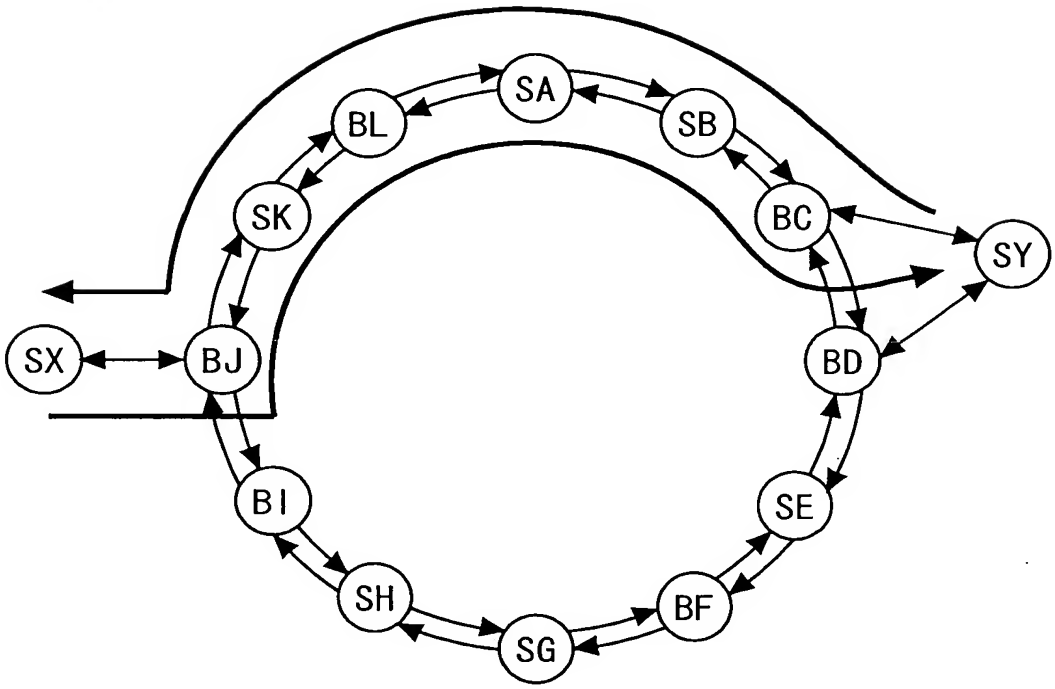


FIG. 27

PRIOR ART

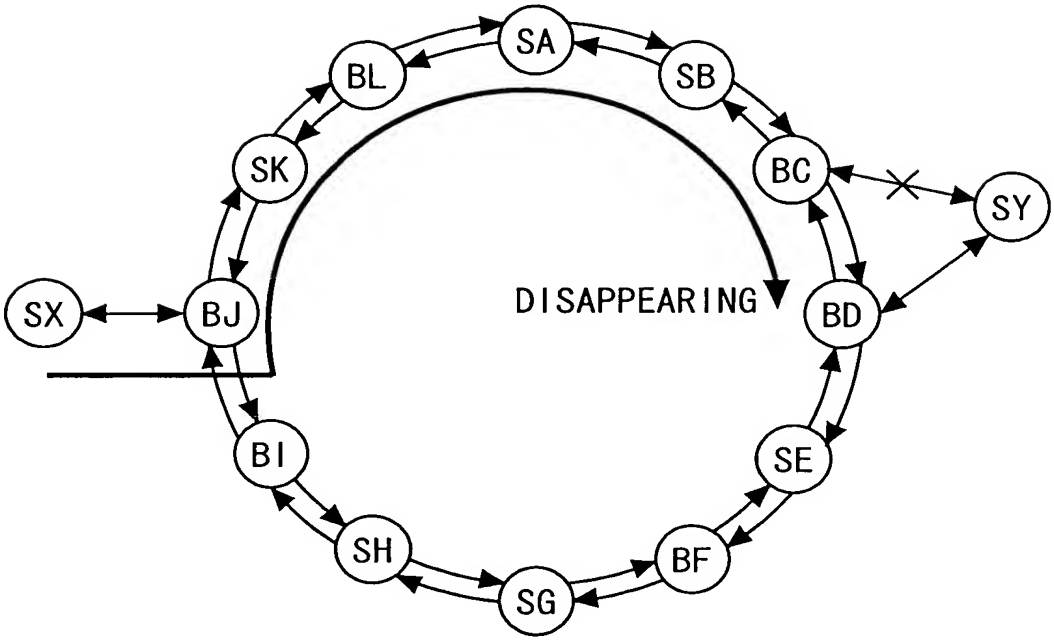


FIG. 28

PRIOR ART

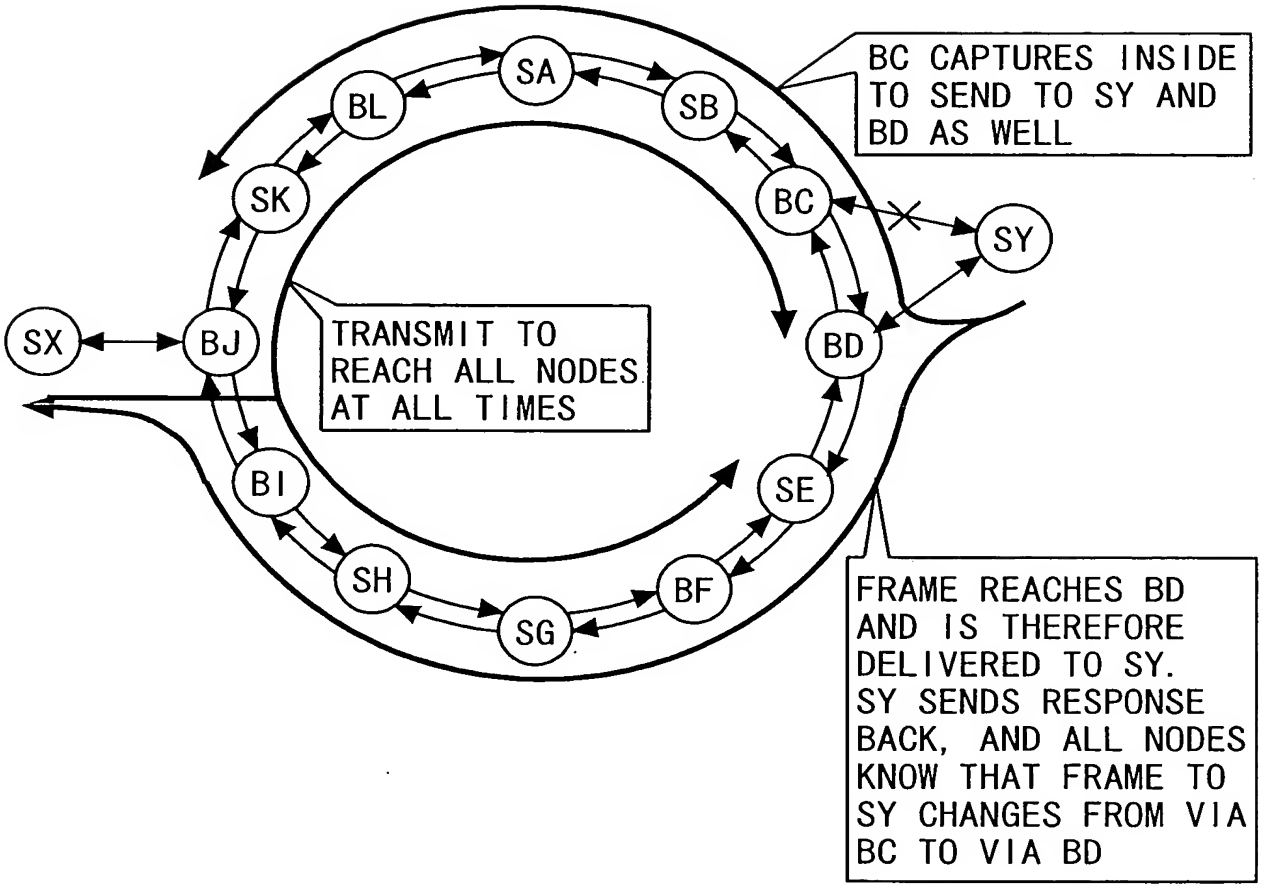


FIG. 29
PRIOR ART

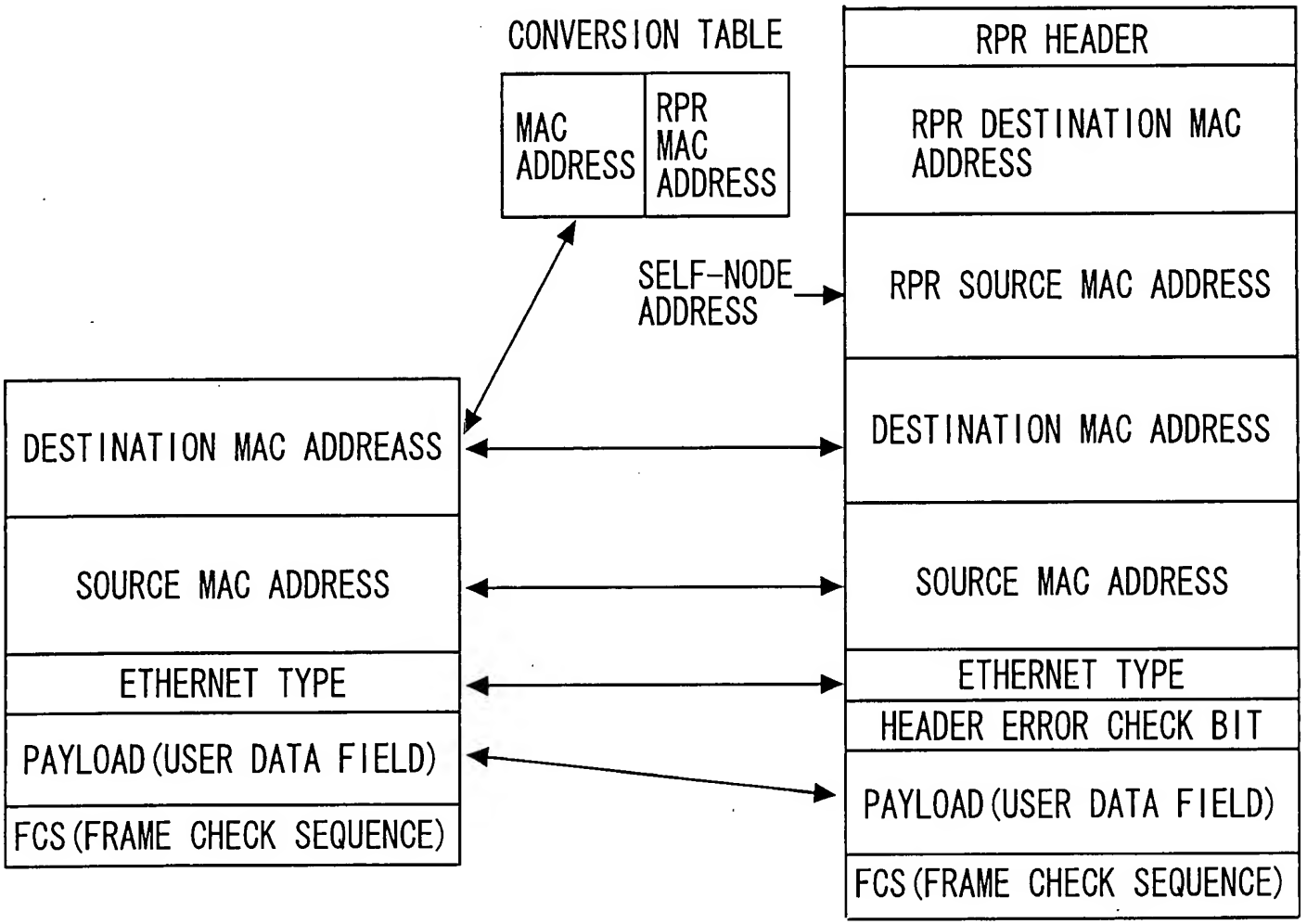


FIG. 30
PRIOR ART

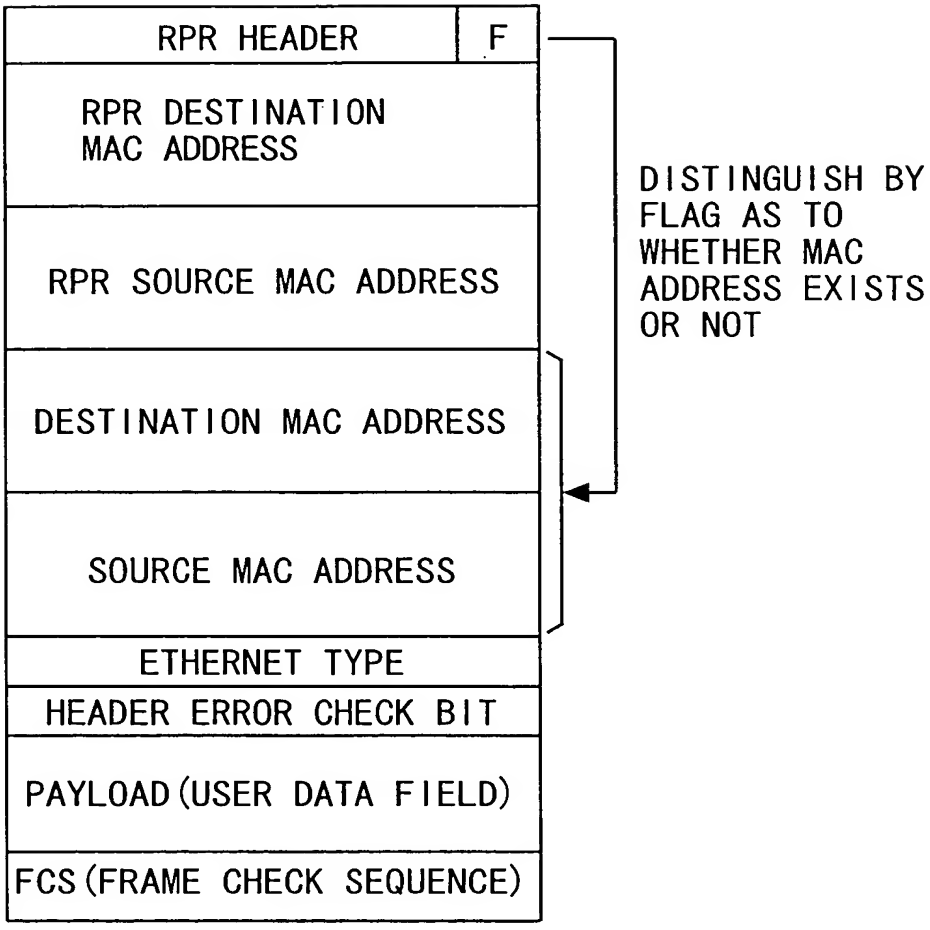


FIG. 31

PRIOR ART

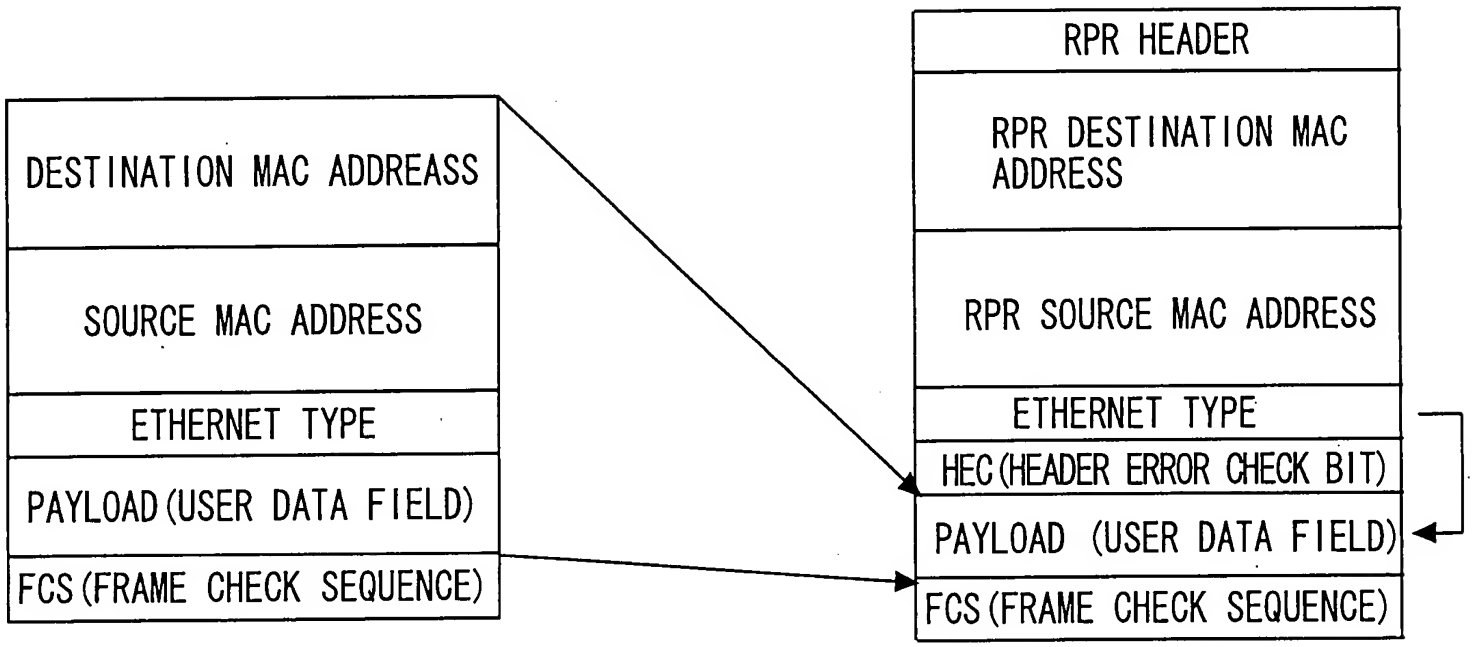


FIG. 32
PRIOR ART

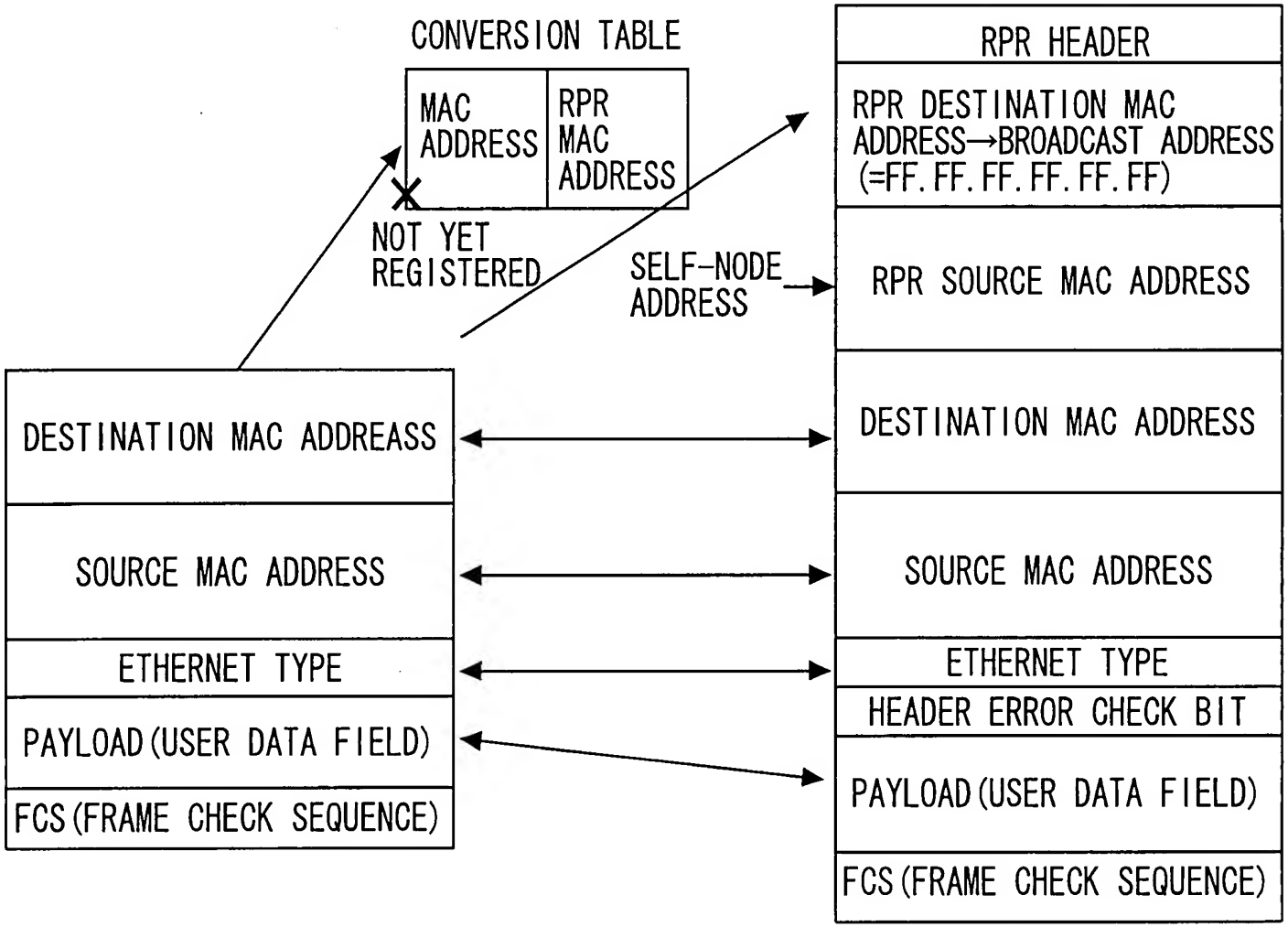


FIG. 33

PRIOR ART